PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 11 July 2001 (11.07.01)	
International application No. PCT/US00/40807	**Applicant's or agent's file reference** 49922.2WOPT
International filing date (day/month/year) 01 September 2000 (01.09.00)	**Priority date** (day/month/year) 02 September 1999 (02.09.99)
Applicant SHENG, Xiayang	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

28 March 2001 (28.03.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Charlotte ENGER
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

12

Applicant's or agent's file reference 49922.2WOPT	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/US00/40807	International filing date *(day/month/year)* 01 September 2000 (01.09.2000)	Priority date *(day/month/year)* 02 September 1999 (02.09.1999)
International Patent Classification (IPC) or national classification and IPC IPC(7): F16K 15/20 and US Cl.: 137/ 226 ; 152/415		
Applicant SHENG, XIAYANG		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 10 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of report with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
28 March 2001 (28.03.2001)	06 November 2001 (06.11.2001)
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer Michael Buiz Telephone No. 703 308 0861

Form PCT/IPEA/409 (cover sheet)(July 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International Application No.
PCT/US00/40807

I. Basis of the report

1. With regard to the elements of the international application:*

☐ the international application as originally filed.

☒ the description:
pages 1-6, 8-9, 16-17 as originally filed
pages NONE, filed with the demand
pages 7, 10-15, 18 ,19, filed with the letter of 14 August 2001 (14.08.2001)

☒ the claims:
pages 20 and 22-24, as originally filed
pages NONE, as amended (together with any statement) under Article 19
pages NONE, filed with the demand
pages 21, filed with the letter of 14 August 2001.

☒ the drawings:
pages 1-9, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

☐ the sequence listing part of the description:
pages NONE, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination(under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in printed form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages NONE

☐ the claims, Nos. NONE

☐ the drawings, sheets/~~fig~~ NONE

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

*** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

WRITTEN OPINION

International Application No.
PCT/US00/40807

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. STATEMENT

Novelty (N)	Claims 8-30	YES
	Claims 1-7	NO
Inventive Step (IS)	Claims 8, 11, 13-17, and 23 -30	YES
	Claims 1-7, 9, 10, 12 and 18 -22	NO
Industrial Applicability (IA)	Claims 1-30	YES
	Claims NONE	NO

2. CITATIONS AND EXPLANATIONS

Claims 1-7 lack novelty under PCT Article 33(2) as being anticipated by MAGNUSON et al. MAGNUSON et al shows a pressure regulator having a valve system, an inlet, an outlet, a piston, a spring, which is capable of deflation. The claim language only requires that the bias is in response to a desired pressure, which is not specified. Since MAGNUSON is capable of responding to the supply pressure, it is seen as meeting the claim language.

Claim 9 lacks an inventive step under PCT Article 33(3) as being obvious over MAGNUSON et al in view of SUMRALL. SUMRALL discloses using a Schrader valve. To use the Schrader valve of SUMRALL in the device of MAGNUSON et al would not require an inventive step since the Schrader valve is a common valving device.

Claim 10 lacks an inventive step under PCT Article 33(3) as being obvious over MAGNUSON et al in view of TUAN et al. TUAN et al discloses using ball valve. To use the ball valve of TUAN et al in the device of MAGNUSON et al would not require an inventive step since the ball valve of TUAN et al is a common valving device.

Claims 12, 21, and 22 lack an inventive step under PCT Article 33(3) as being obvious over MAGNUSON et al in view of MOORE. MOORE discloses using a reed and a visible flow indicator. To use the reed and visible flow indicator of MOORE in the device of MAGNUSON et al would not require an inventive step since it is well known to indicate by an audible or visual method the amount of flow through the device.

Claims 18, 19, and 20 lack an inventive step under PCT Article 33(3) as being obvious over MAGNUSON et al in view of BERA et al. BERA et al discloses a pressure indicator attached outside the conduit. To use the pressure indicator of BERA et al in the device of MAGNUSON et al would not require an inventive step since it is well known to indicate the pressure of a the tire.

Claims 8,11,13 -17, and 23-30 meet the criteria set out in PCT Article 33(2) and (3), because the prior art does not teach or fairly suggest a device and method for inflating and deflating a tire to a desired pressure setting without going through a trial and error process .

Claims 1- 30 meet the criteria set out in PCT Article 33(4), the subject matter can be made or used in industry.

inflated. The regulator can inflate or deflate the low pressure receiving object automatically to a predetermined pressure value. In some embodiments, the regulator can also generate an audible buzzing sound during inflation or deflation, which helps the user to identify the inflation or deflation status.

The term "fluid" used herein refers to any material which flows under pressure, including but not limited to, gases, liquids, and semi-solids, and combinations thereof. A preferred fluid is air. "Low pressure receiving object" or "inflatable object" herein refers to any hollow object which is capable of receiving a fluid therein. It includes, but is not limited to, tires, balloons, toys, lifesavers, beach balls, etc. A preferred inflatable object is a tire.

Referring to Fig. 1, the regulator comprises a hollow cylindrical casing 10, an adapter 20, a valve system 30, a tubular conduit 40 for allowing fluid passage from a high pressure source to a low pressure receiving object, a pressure-sensing structure (e.g., a piston) 50, a coil spring 60, a dynamic seal 70, a reed 80 (which is optional), and a hollow shaft 90. Although the conduit is preferably straight, it can take any other shapes, such as curved, helical, etc.

One end of the cylindrical casing 10 is connected to one end of the hollow shaft 90 by threads that allow the shaft 90 to be screwed in or out of the casing 10. While the end of the casing 10 provides a fluid inlet connected to a high pressure source (not shown) designated as "HI," the other end of the shaft 90 provides a fluid outlet to a low pressure receiving object (not shown) designated as "LO."

The valve system 30 (e.g., a standard tire valve core such as a Shrader valve) is placed in the high pressure fluid inlet side of the casing 10 by a threaded adapter 20. The seal portion 34 of the valve system 30 preferably is firmly tightened against the seat 22 inside the adapter 20. Sealing materials, such as polytetrafluroethylene tapes, may be used on the threads between the adapter 20 and the casing 10 to ensure a good seal. Any sealing materials can be used.

If the pressure in the receiving object is lower than the preset value on the pressure regulator, inflation begins. The fluid flows from the high pressure source into the low pressure receiving object through the valve system 30, the conduit 40 and the reed 80. The passing fluid blows the reed 80, generating a buzzing sound. As the pressure in the receiving object approaches the predetermined pressure value, the piston 50 is gradually forced to move away from the valve stem 36. Consequently, the valve 32 gradually returns to its normally closed position and eventually terminates the inflation process as shown in Fig. 3. The reed 80 stops buzzing when the fluid flow is terminated.

If the pressure in the receiving object is initially higher than the preset value but lower than the maximum allowed pressure, the regulator is not actuated and the piston 50 is in a balance position as shown in Fig. 3. No sound is generated from the reed 80.

If the pressure in the receiving object is initially higher than the maximum allowed pressure, the piston 50 moves away from the valve stem 36 and further passes the port 12 on the side wall of the casing 10, which permits the deflation of the receiving object. The fluid from the receiving object flows outside the casing 10 through the reed 80, the conduit 40, and the port 12. The reed 80 generates a different buzzing sound. When the pressure in the receiving object falls below the maximum allowed value, the piston 50 returns to the balance position, and the deflation process is terminated. The buzzing also stops.

Figs. 5-7 show another embodiment of the pressure regulator. It has similar configurations, mechanisms, and substantially the same functions, but utilizes a different valve system, different piston, different dynamic seal, different spring compression mechanism and different pressure indicator.

Referring to Figs. 5-7, the second embodiment of the pressure regulator comprises a hollow cylindrical casing 15, a ball valve seat 23, a ball valve 25, a ball valve spring 27, a ball valve spring support 29, a conduit 35, a pressure-sensing structure (e.g., an O-ring

piston) 45, a spring 55, a spring collar 61, two screws 63, a nut 65, a bellows 75, and a pressure indicator 95.

The hollow cylindrical casing 15 has at least one slot 11 (preferably two slots) on the side wall of the casing 15 in the longitudinal direction (i.e., the lengthwise direction of the hollow casing 15). The casing 15 also has numerical pressure marks 95 on the side wall. The casing 15 further includes inside and outside threads at both ends. One end of the casing 15 provides a fluid inlet from a high pressure source (not shown) designated as "HI," and the other end of the casing 15 provides a fluid outlet to a low pressure receiving object (not shown) designated as "LO."

A valve system is provided by the ball valve seat 23, the ball valve 25, the ball valve spring 27, and the ball valve spring support 29. The seat 23 has a center bore and is placed into the fluid inlet of the casing 15 through a plurality of threads. The ball 25, due to the compression of the spring 27, normally closes the center bore of the seat 23. The ball spring support 29 is screwed into the fluid inlet of the casing 15 to control the compression of the spring 27. The support 29 has a hole to allow the fluid in the high pressure source to flow into the valve system.

One end of the conduit 35 normally contacts the top of the ball 25 through the center bore of the valve seat 23. The diameter of the center bore of the seat 23 preferably is larger than the outside diameter of the conduit 35. The other end of the conduit 35 is connected to one end of the bellows 75. Another end of the bellows is connected to an adapter 77 in the fluid outlet of the casing 15. An O-ring piston 45 is placed inside the casing 11 at a location close to the ball valve 25. The O-ring 45 is positioned in a piston groove 37 and in contact with the inner wall of the casing 15, which allows the piston to slide without fluid leak. At least one port 33 is formed on the conduit 35 between the O-ring 45 and the ball 25 to facilitate fluid flow.

The spring 55 surrounds the conduit 35. One end of the spring 35 is seated on the piston shoulder 39 while the other end is held in contact with the spring collar 61. One or more screws 63 are radially screwed into the spring collar 61 through a slot 11 (which may be two or more slots) on the side wall of the casing 15. The screws 63 are long enough to extend out of the casing 15, with their side faces contacting the bottom of the nut 65. The nut 65 has inner threads and can move along the outside threads of the casing 15 as the nut 65 turns.

The casing 15 has at least one unthreaded portion (or side) where a pressure scale 95 is marked numerically. The scale 95 is calibrated so that when aligned with the end of the nut 65 or other pressure indicators, the number on the scale represents the desired pressure value in the fluid receiving object after inflation.

The slot 11 on the side wall of the casing 15 is used to set the upper limit of the desired pressure or the maximum allowed pressure in the fluid receiving object. The distance from the O-ring 45 to the bottom edge of the slot 11 represents the upper pressure limit.

To preset the desired pressure for the fluid receiving object, the nut 65 is turned up or down along the threaded casing 15 until the desired reading of the pressure mark 95 is aligned with the lower edge of the nut 65. The nut 65 forces the screws 63 to slide along the slot 11 on the side wall of the casing 15. The spring collar 61 connected to the screws 63 then compresses the spring 55 and produces a bias force against the piston shoulder 39. The conduit 35 with the piston pushes the ball 25 down and opens up the normally closed ball valve.

When the fluid inlet and fluid outlet of the casing 15 are connected to a high pressure fluid source and a fluid receiving object, respectively, three scenarios can occur similar to those shown in Figs. 2, 3 and 4, depending on the initial pressure in the fluid receiving object.

If the pressure in the receiving object is lower than the desired value, inflation begins. The fluid flows from the high pressure source into the low pressure receiving object through the ball valve spring support 29, the ball valve seat 23, the conduit 35, the bellows 75, and the adapter 77. As the pressure in the receiving object approaches the predetermined pressure value, the piston 45 is gradually forced to move away from the top of the ball 25. Meanwhile, the valve spring 27 pushes the ball 25 back to the original close position and eventually terminates the inflation process.

If the pressure in the receiving object is initially higher than the preset value but lower than the maximum allowed pressure, the regulator is not actuated.

If the initial pressure in the receiving object is higher than maximum desired pressure, the O-ring 45 moves away from the top of the ball 25 and passes the bottom edge of the slot 11, permitting deflation of the receiving object. The fluid from the receiving object flows into the atmosphere through the adapter 77, the bellows 75, the conduit 35, and the slot 11. When the pressure in the receiving object falls below the maximum desired pressure, the O-ring 45 returns to its balance position, and the deflation process terminates.

Figs. 8 and 9 show another embodiment of the invention, which is modified from the first embodiment of Fig. 1. First, the audible reed 80 of Fig. 1 is replaced by a visible ball display 200 in this embodiment, which is suited for use in a noisy environment. Second, the valve core 30 of Fig. 1 is replaced by the rubber stopper 300 in this embodiment and the piston system is turned upside down. With this design, the regulator may lose its deflating function, but its valve system is simplified as a piece of rubber stopper. An advantage of this rubber stopper is that it is fixed to the inner wall of the casing 100 and is not affected by fluid pressure.

The pressure regulator as shown in Figs. 8 and 9 comprises a hollow cylindrical casing 100, a ball display 200, a rubber stopper 300, an O-ring 400, a spring compression collar 500, a coil spring 600, a pressure-sensing structure (e.g., a piston) 700, a tubular

conduit 800, a supporter 900, two screws 130, a screw holder 140, a pressure adjuster 120, a piece of sight glass 210, a coil spring 220, and an O-ring holder 410.

One end of the cylindrical casing 100 includes a fluid inlet for connection to a high pressure source (not shown) designated as "HI," the other end includes a fluid outlet to a low pressure receiving object (not shown) designated as "LO." At least one port 150 is formed on the side wall of the casing 100 close to the inlet end. The port 150 is sealed with transparent sight glass 210 in the cylindrical casing 100. The sight glass 210 is a hollow cylinder which allows fluid to pass through. The inner wall of the sight glass 210 preferably is tapered. The tapered end faces the fluid inlet. A color ball 200 is located in the sight glass 210 and held by a spring 220. The rubber stopper 300 supports the spring 220. The rubber stopper 300 is fixed to the inner wall of the casing 100 and has at least one bore 310 allowing fluid to pass through. The ball 200 can be any color, including but not limited to black, white, red, yellow, blue, pink, green, etc.

One end of the tubular conduit 800 is beneath the rubber stopper 300, and the other end sits on the supporter 900. The supporter 900 has at least one bore to allow the fluid to flow through, and it is fixed to the inner wall of the casing 100. The O-ring 400 dynamically seals the outer wall of the conduit 800. An O-ring holder 410 holds the O-ring 400. The O-ring holder preferably is tightly bonded to the inner wall of the casing 100 so that no fluid can pass through it. A color mark 810 is placed outside the conduit 800 and is aligned with a slot 160 of the casing 100. The mark 810 indicates the relative position of the piston 700. The piston 700 is attached to the other end of the tubular conduit 800, and its lip 710 contacts the inner wall of the casing 100 to form a dynamic seal.

One end of the coil spring 600 sits on the piston 700, and the other end is held by the spring collar 500. One or more screws 130 are connected to the spring collar 500 and extend out of one or more slots 160. The screw 130 is fixed to the screw holder 140. The hollow screw holder 140 covers the lower part of the slots 160 and can move up or down along the casing 100 by a pressure adjuster 120. One end of the pressure adjuster 120 is connected to

the outer wall of the casing 100 through a plurality of threads, while the other end can slide over the casing 100 and align with the pressure scale mark 110 on the outer wall of the casing 100. The transparent pressure adjuster 120 covers the upper part of the slot 160 and allows the piston position mark 810 to be seen. Both the screw holder 140 and the pressure adjuster 120 can also protect the slots 160 from dust.

To preset the pressure for the fluid receiving object, the pressure adjuster 120 is turned up or down along the casing 100 until a desired reading of the pressure mark 110 is aligned with the lower edge of the pressure adjuster 120. The pressure adjuster 120 forces the screw holder 140 with the screws 130 to slide along the slots 160 on the side wall of the casing 100. The spring collar 500 connected to the screws 130 then compresses the spring 600 and produces a bias force against the piston 700.

When the fluid inlet and fluid outlet of the casing 15 are connected to a high pressure fluid source and a fluid receiving object, respectively, inflation begins if the pressure in the receiving object is lower than the desired value. As shown in Fig. 10, the fluid flows from the high pressure source into the low pressure receiving object through the ball display system 200, the hole 310 in the rubber stopper 300, the tubular conduit 800, and the hole of the supporter 900. The flowing fluid pushes the ball 200 downward and indicates the ongoing inflating status. When the pressure in the receiving object reaches the predetermined pressure value, the piston 700 is forced to move away from the top of the supporter 900. Meanwhile, the piston 700 pushes the upper end 820 of the tubular conduit 800 onto the bottom 320 of the rubber stopper 300, and the inflation process terminates. Since no fluid exerts force on the ball 200, the spring 220 pushes the ball 200 back to its original position as shown in Fig. 11. The user can observe the position of the ball 200 through the port 150 and the sight glass 210 to determine the status of the inflation process.

If the pressure in the receiving object is initially equal to or higher than the preset value, the regulator is not actuated, and the ball 200 remains at the original position as shown in Fig. 11.

in a cost-effective manner. It can be used in any flow control process in which a fluid flows from a relatively higher pressure source to a relatively lower pressure receiving object.

It should be recognized that each of the components described above can be substituted by its functional equivalents or structural equivalents. For example, the pressure-sensing structure encompasses any device or structure which moves in response to pressure differential. It includes, but is not limited to, pistons, diaphragms, bellows, etc. Any type of pistons can be used. Although an adjustable spring compression mechanism is used in all the examples of this invention as mentioned above, a fixed spring compression mechanism can also be used if necessary. For instance, many cars require only one tire pressure value, such as 32 psi. In this case, the spring adjuster of the new tire valve of Figs. 16 and 17 is not needed, and the spring collar can be fixed on the inner wall of the casing where a 32 psi pressure is generated as shown in Fig. 18 and 19. This would further simplify the new tire valve.

In addition, the spring compression mechanism can be achieved by a screw, a pin, friction or other fixing methods. The coil springs can be replaced by any other springs, such as Belleville springs, gas springs, and polymer springs. Any other style valves can also be used in addition to a standard tire valve, a ball valve and a rubber stopper as mentioned above. The audible reed or the visible ball display may be replaced by any other display or warning indicators to indicate the fluid flow status if needed.

Functional equivalents that can be used in embodiments of the invention to replace one or more components are those which perform substantially the same function; but they need not perform the function in substantially the same way and achieve the substantially the same result. A functional equivalent may have a different structure. On the other hand, structural equivalents that can be used in embodiments of the invention to replace one or more components are those which has similar structures but may perform more functions or less functions. Suitable functional equivalents or structural equivalents include both known and unknown equivalents. Following U.S. patents disclose various parts or components

which may be used to replaced or be combined with one or more components in embodiments of the invention: 6,067,850; 5,878,774; 5,857,481; 5,855,281; 5,819,780; 5,819,779; 5,816,284; 5,780,734; 5,778,923; 5,694,969; 5,628,350; 5,398,744; 5,365,967; 5,309,969; 5,295,504; 5,293,919; 5,181,977; 5,159,961; 5,135,023; 5,094,263; 5,054,511; 5,029,604; 4,991,618; 4,944,323; 4,922,946; 4,901,747; 4,895,199; 4,884,593; 4,883,107; 4,869,306; 4,768,564; 4,768,460, 4,708,169; 4,681,148; 4,660,590; 4,658,869; 4,598,750; 4,489,855; 4,474,207; 4,464,929, 4,462,449, 4,445,527; 4,340,080; 4,310,014; 4,244,214; 4,153,096; 4,126,161; 4,120,614; 4,117,281; 4,076,037; 3,994,312; 3,911,988; 3,910,305; 3,830,249; 3,789,867; 3,739,637; 3,537,469; 3,491,786; 3,450,147; 3,426,787; Re. 29,1919; 1,246,131. In addition, PCT Application WO 00/25051 (which claims priority to U.S. provisional application No. 60/105,471, filed on October 23, 1998) also discloses various components that can be used in embodiments of the invention. All of the preceding patents and publication are incorporated herein by reference in their entirety.

While the invention has been described with respect to a limited number of embodiments, variations and modifications therefrom exist. For example, although a preferred pressure regulator should have both inflation and deflation functions, a pressure regulator which only inflates or deflates is still within the scope of the invention. It is possible to combined one or more components in some embodiments to make the devices more compact. For some applications, it may be desirable to incorporate a pressure sensor or a microprocessor into the devices described herein. The inflating or deflating methods are described with respect to a number of steps. These steps can be practiced in any order or sequence. One or more steps may also be practiced simultaneously. The appended claims intend to encompass all such variations and modifications as falling within the scope of the invention.

What is claimed is:

6. The pressure regulator of claim 1, wherein the pressure-generating structure is a coil spring disposed between the pressure-sensing structure and a spring collar.

7. The pressure regulator of claim 6, wherein the side wall of the hollow casing includes a port between the pressure-sensing structure and the spring collar, and the port is capable of releasing fluid from the inflatable object when the pressure inside the object exceeds the desired pressure.

8. The pressure regulator of claim 7, wherein the distance between the port and the pressure-sensing structure is proportional to the maximum pressure allowed for the inflatable object.

9. The pressure regulator of claim 1, wherein the valve system is a Shrader valve.

10. The pressure regulator of claim 1, wherein the valve system is a ball valve.

11. The pressure regulator of claim 1, wherein the valve system is actuated by the conduit which moves longitudinally with the pressure-sensing structure in response to the pressure differential between the two sides of the pressure-sensing structure.

12. The pressure regulator of claim 1, further includes a reed disposed in the fluid flow path.

13. The pressure regulator of claim 12, wherein the reed comprises two sound-generating pieces; the first piece generates a buzzing sound during inflation; and the second piece generates a different buzzing sound during deflation.

14. The pressure regulator of claim 6, wherein the spring collar is connected to at least one screw which extends outside the side wall of the hollow casing.

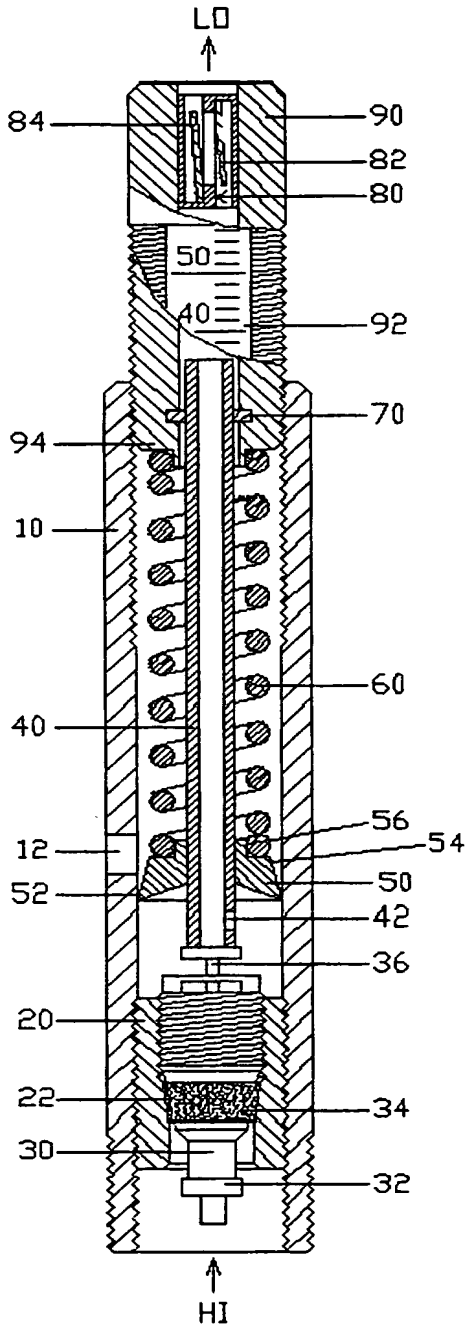
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Fig. 1

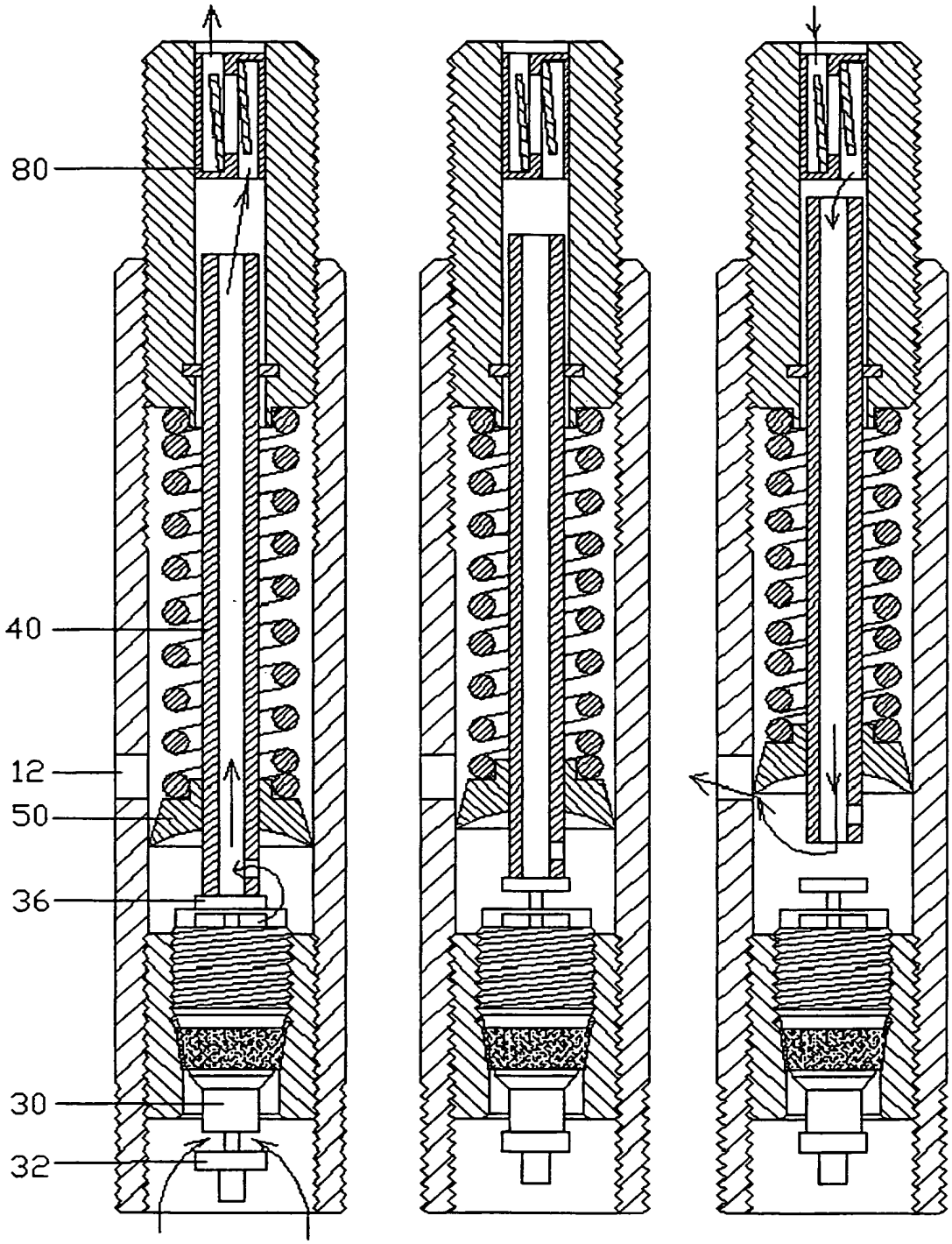

Fig. 2 Fig. 3 Fig. 4

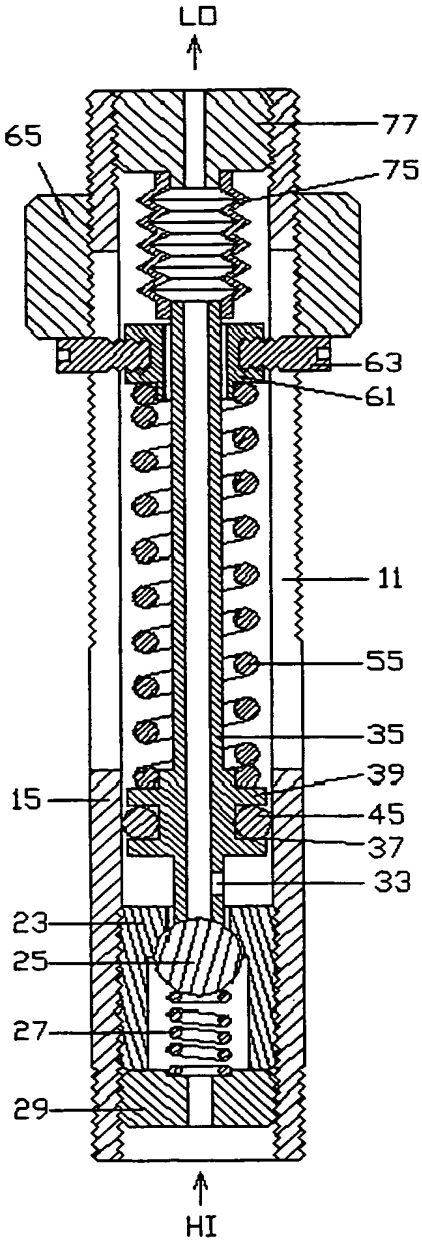

Fig. 5

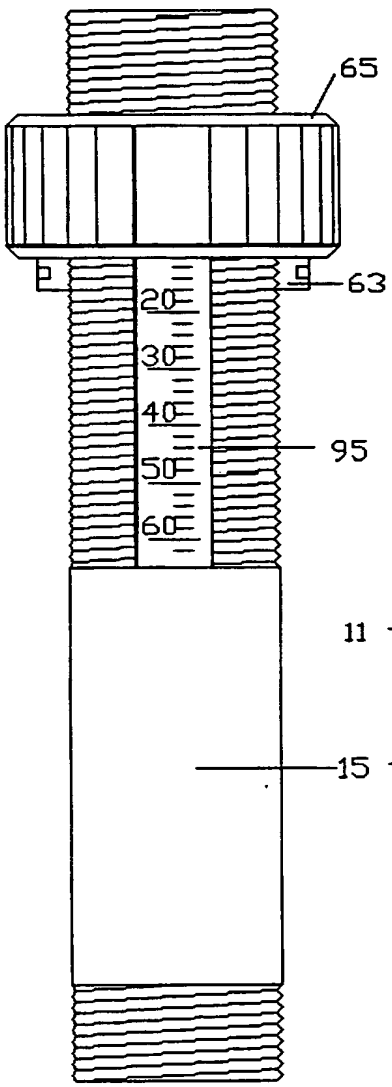

Fig. 6

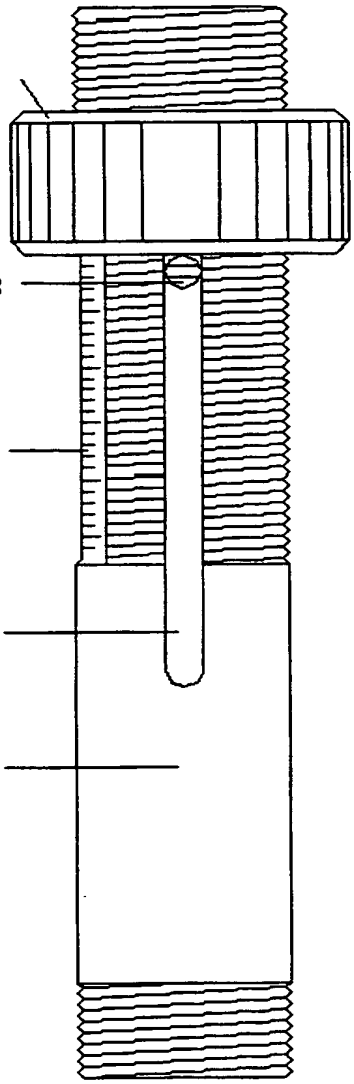

Fig. 7

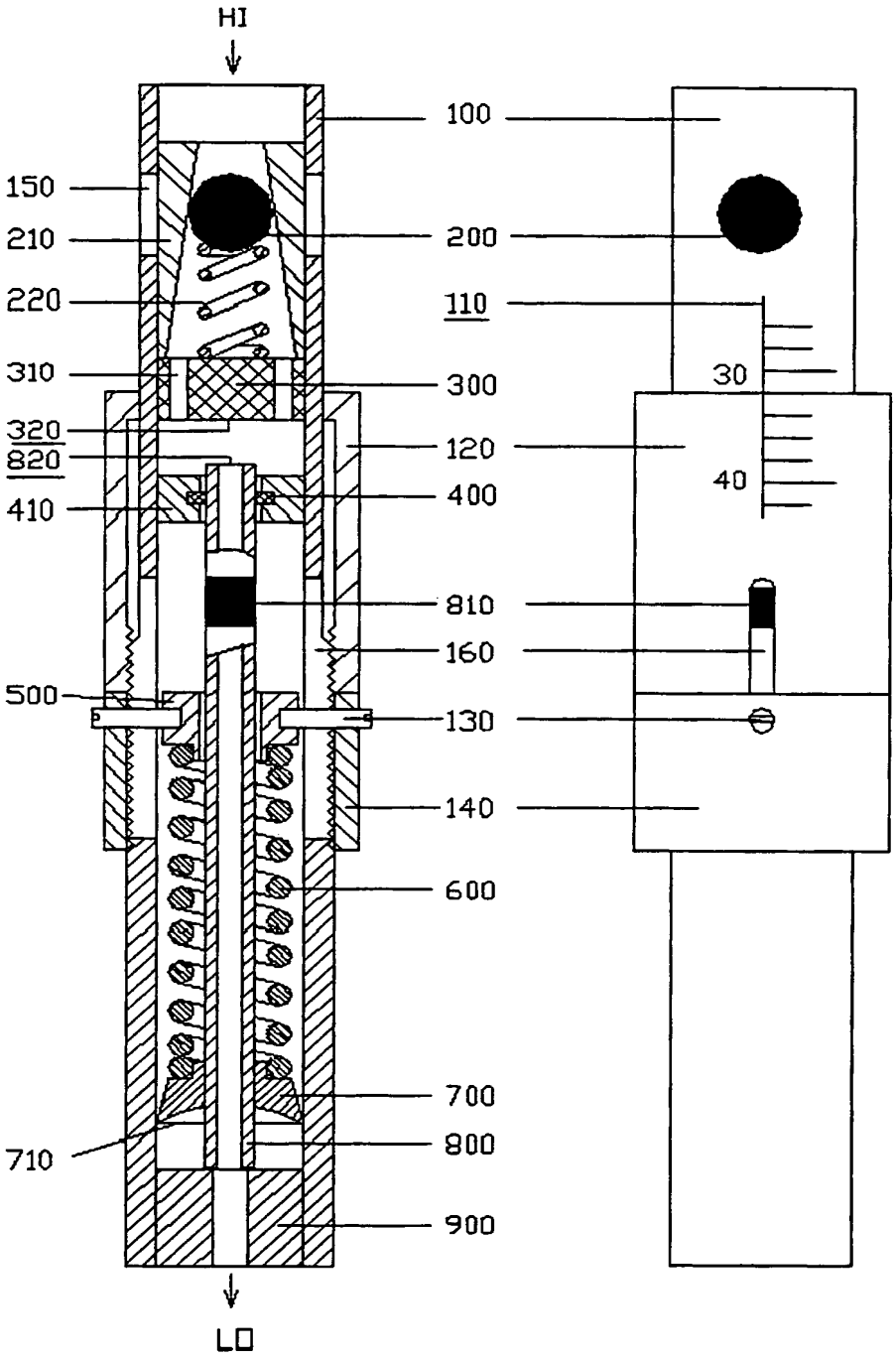
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Fig. 8

Fig. 9

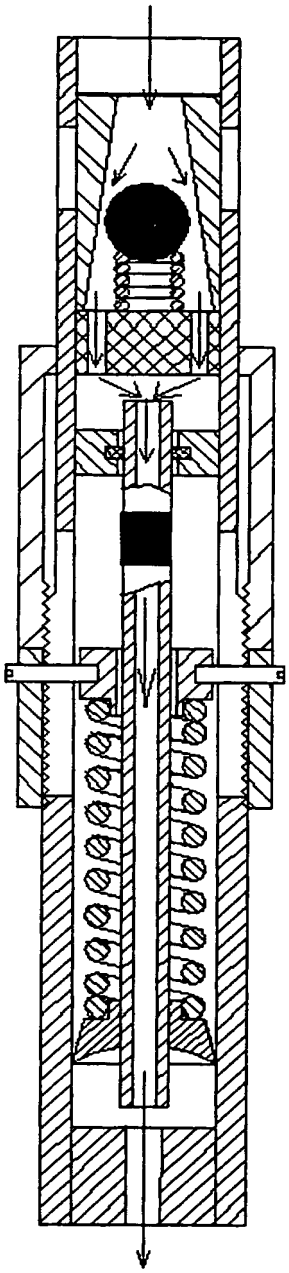

Fig. 10

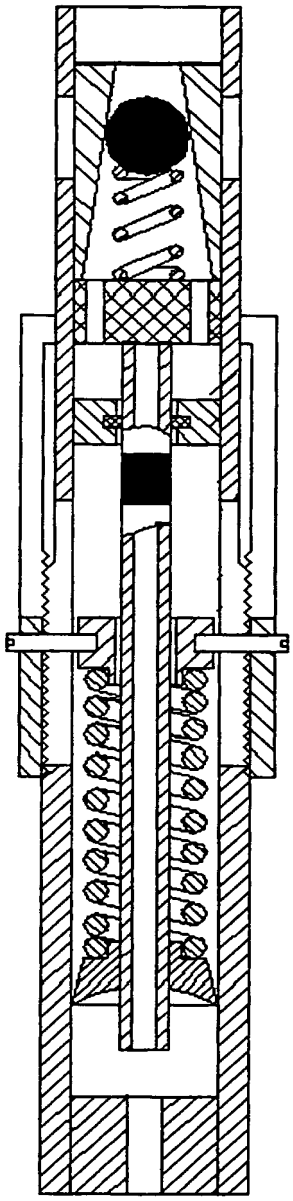

Fig. 11

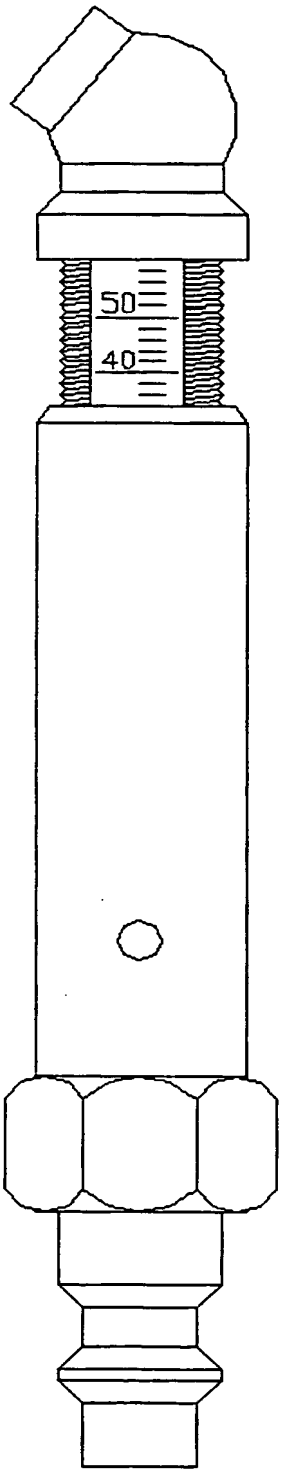

Fig. 12

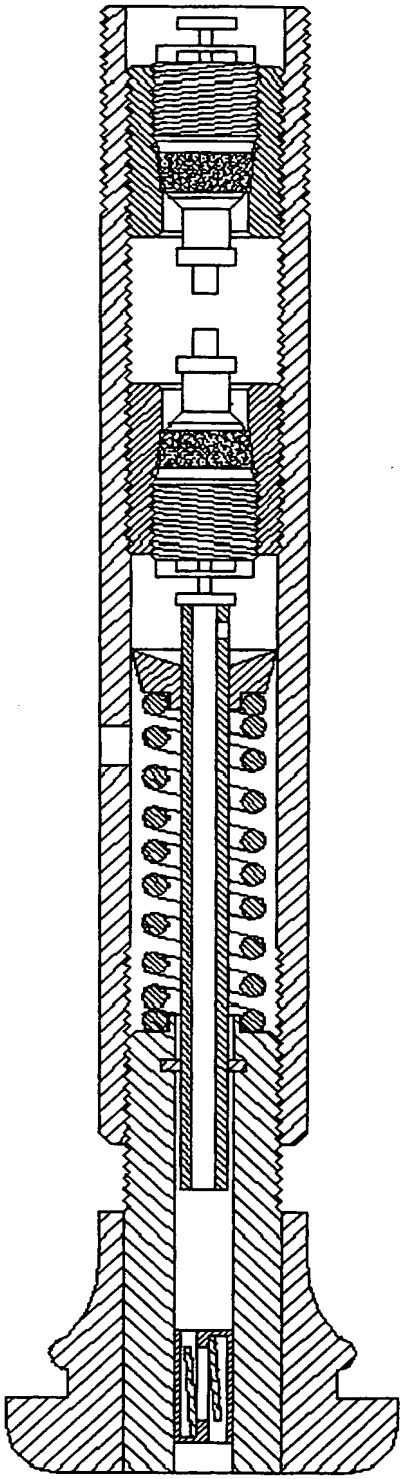

Fig. 13

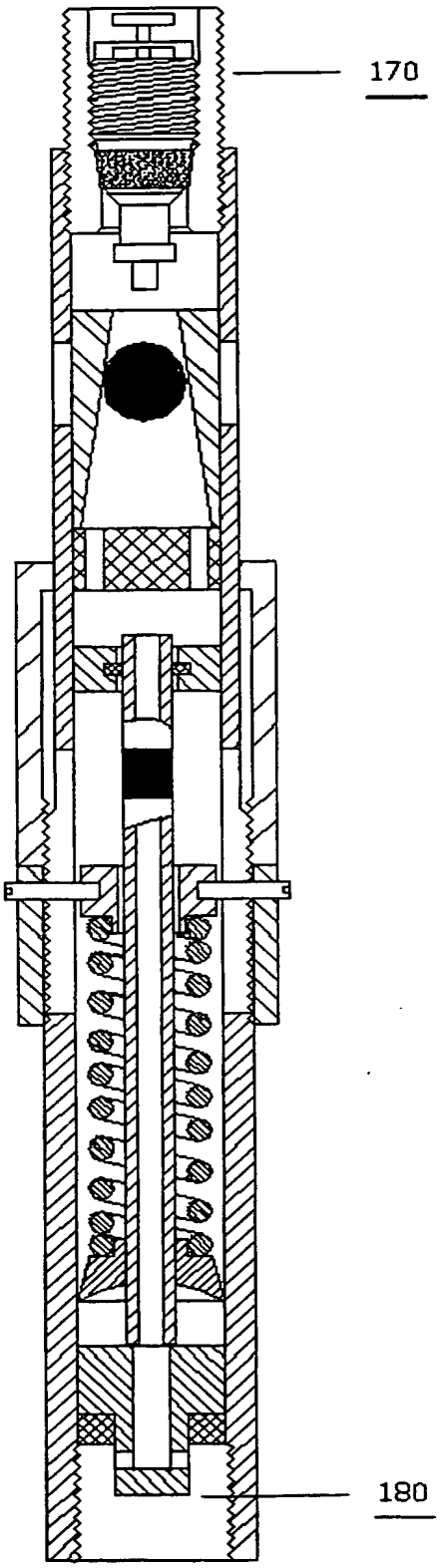

Fig. 14

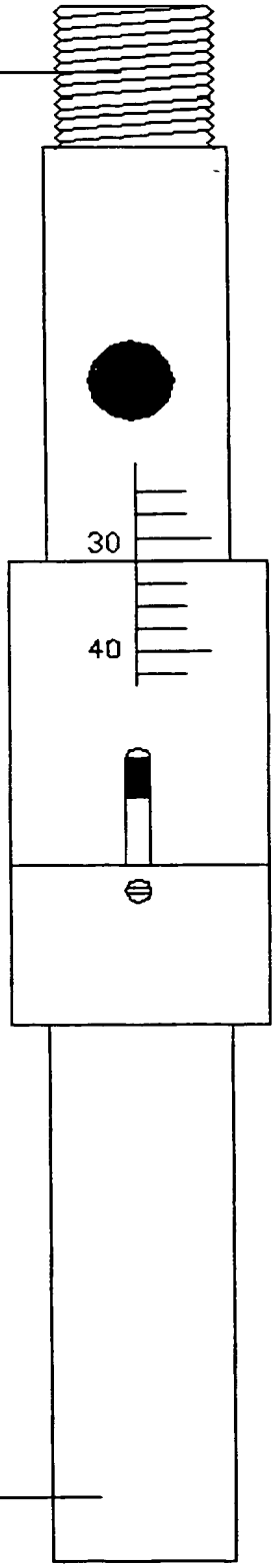

Fig. 15

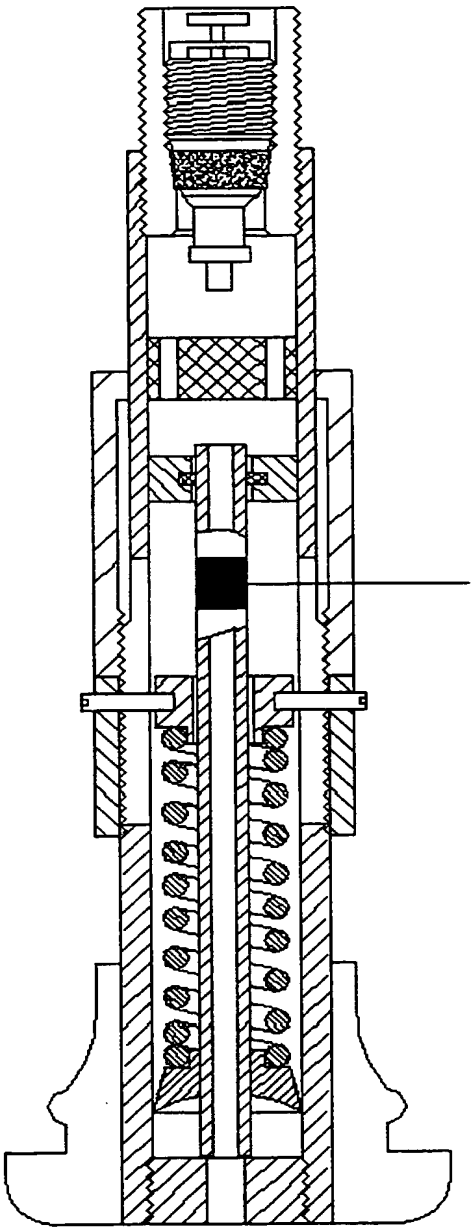

Fig. 16

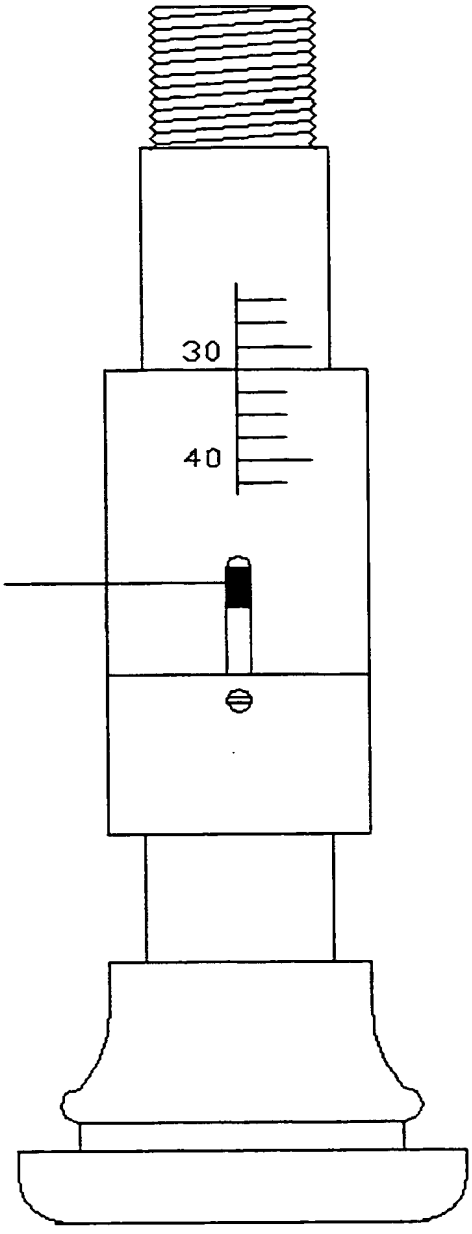

Fig. 17

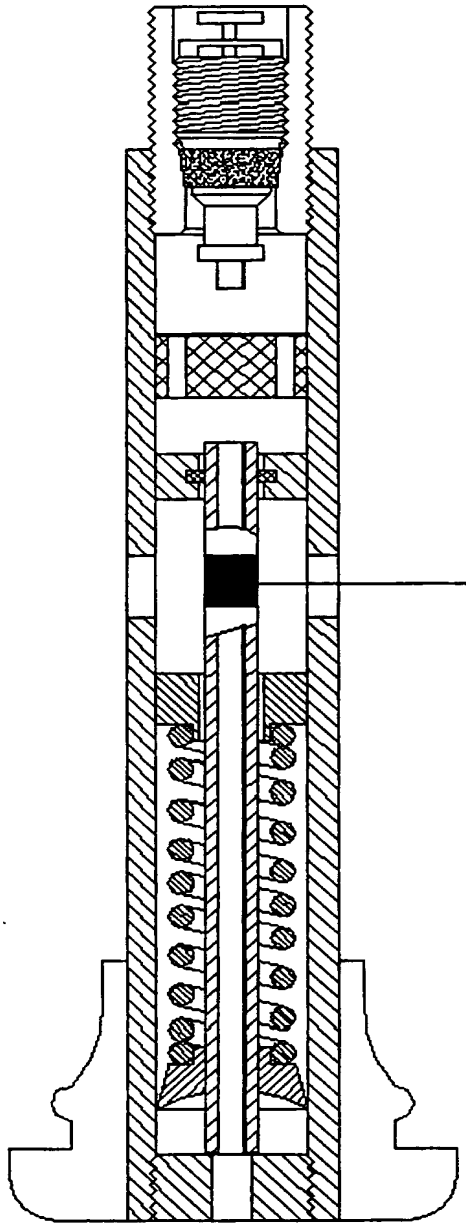

Fig. 18

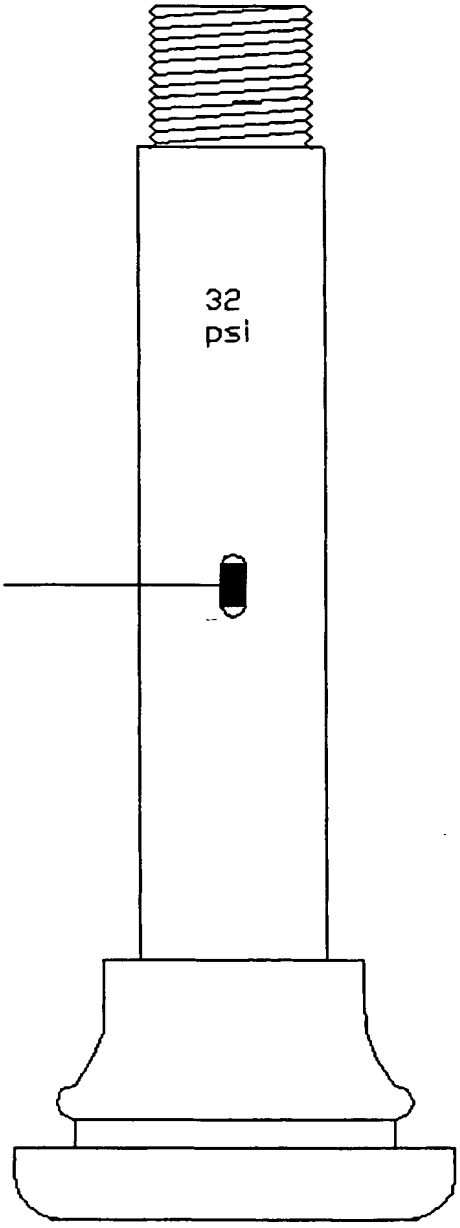

Fig. 19

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(71) Applicant and
(72) Inventor: SHENG, Xiayang [CN/US]; 12626 Mesquite Hollow, Sugar Land, TX 77478 (US).

(74) Agent: BAI, J., Benjamin; Jenkens & Gilchrist, 1100 Louisiana, Suite 1800, Houston, TX 77002 (US).

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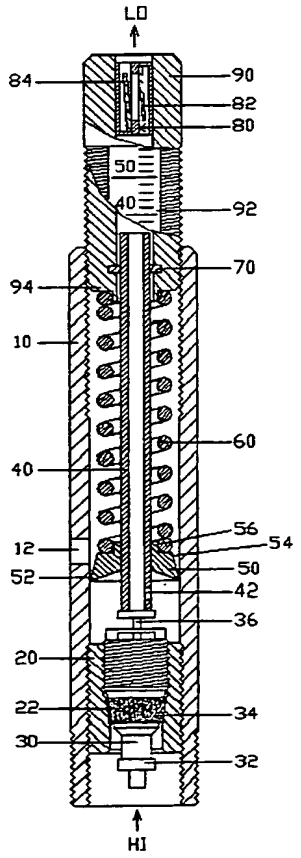
[Continued on next page]

(54) Title: PRESSURE REGULATOR AND METHOD OF USE



(57) Abstract: A user-friendly pressure regulating device and method of using the device are provided. The pressure regulating device comprises (a) a hollow casing (10), (b) a valve system (30) positioned inside the hollow casing (10), (c) a fluid inlet connected to the valve system (30), (d) a fluid outlet (12), (e) a fluid conduit (40) positioned inside the hollow casing (10) between the fluid inlet (end of casing 10) and the fluid outlet (12), (f) a pressure-sensing structure (e.g., a piston (50)) attached to the conduit (40) and being movable inside the hollow casing (10) and attached to the pressure sensing structure (50). (g) A pressure generating structure disposed inside the hollow casing (10) and attached to the pressure sensing structure (50). The pressure generating structure (60) can exert a bias force upon the pressure sensing structure (50) in proportion to a desired pressure in the inflatable object. The pressure regulator can inflate the object when the initial pressure inside the inflatable object is lower than the desired pressure and automatically terminates inflation when the pressure inside the object reaches the desired pressure.

WO 01/16513 A1

— *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/40807

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US CL. : 137/ 226 ; 152/415

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 137/493.9

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 4, 895, 199 A (MAGNUSON et al) 23 January 1990 (23.01.1990), see entire document.	1-7, --- 9,10,12,14,18-22,26
Y, E	US 6,142,168 A (SUMRALL) 07 November 2000 (7.11.2000), column 2, lines 13 -23.	9
Y	US 5,054,511 A (TUAN et al) 08 October 1991 (08.10.1991), column 3, line 5.	10
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Y	FR 651, 280 A (BERA et al) 16 February 1929 (16.02.1929), Figure 2.	18,19,20
A	US 3,450,147 A (WEBB) 17 June 1969 (17.06.1969), see entire document.	1-30
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A	US 4,883,107 A (KEYS) 28 November 1989 (28.11.1989), see enitre document.	1-30
A	US 4,896,306 A (KEYS) 26 September 1989 (26.09.1989), see entire document.	1-30
A	US 4,660,590 A (SANCHEZ) 28 April 1987 (28.04.1987), see entire document.	1-30

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C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5,819,779 A (TAKEMURA et al) 13 October 1998 (13.10.1998), see entire document.	1-30